SUBMARINE POWERED, SUBMARINE TRACKING PINGER

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THE UNIVERSITY OF TEXAS AT AUSTIN

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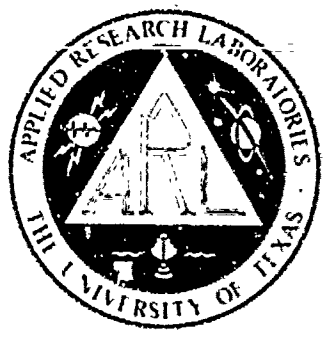

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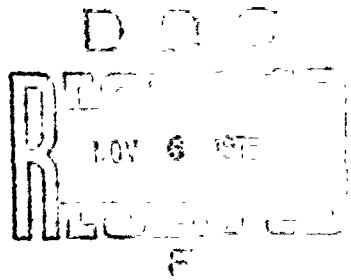

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ABSTRACT

The submarine powered, submarine tracking pinger was designed to provide a signal for accurately tracking the submarine when data are being recorded. The unit operates in synchronization with an on-shore receiver described in a separate report.

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I. INTRODUCTION

The submarine powered, submarine tracking pinger (SP-STP) is designed to mount on submarines to allow the submarine to be accurately tracked by a sonar system. The SP-STP is synchronized to a master clock and produces a pulse every 10 sec (or 5 sec if desired). There are two SP-STP units, which differ only in the precision of each of the 1 MHz oscillators. Unit I has an accuracy of 1 part in 10^{-9} and is the primary unit, and Unit II has an accuracy of 1 part in 10^{-8} and is the backup unit.

II. FRONT PANEL DESCRIPTION (See Fig. 1)

CHARGE--The charge lamp indicates when the battery is being charged.

FUSE--The unit uses a 1 A slo-blo fuse.

SYNC IN--The sync in connector allows a synchronization pulse from the master clock to be applied just prior to installation aboard the submerine.

SYNC OUT--The sync out connector allows the sync pulse generated within the unit to be monitored or used for synchronizing another unit.

1 MHz OUT--The internal 1 MHz clock frequency is brought to the front panel for easy monitoring.

BATT VOLTS--The battery voltage can be monitored by placing a voltmeter on this connector.

V OUT--The voltage output to the transducer cable can be monitored at this point.

I OUT--The current through the transducer is coupled through a transformer to the front panel.

OUTPUT--The output connector provides the 500 W of power to drive the transducer. The output is isolated from ground.

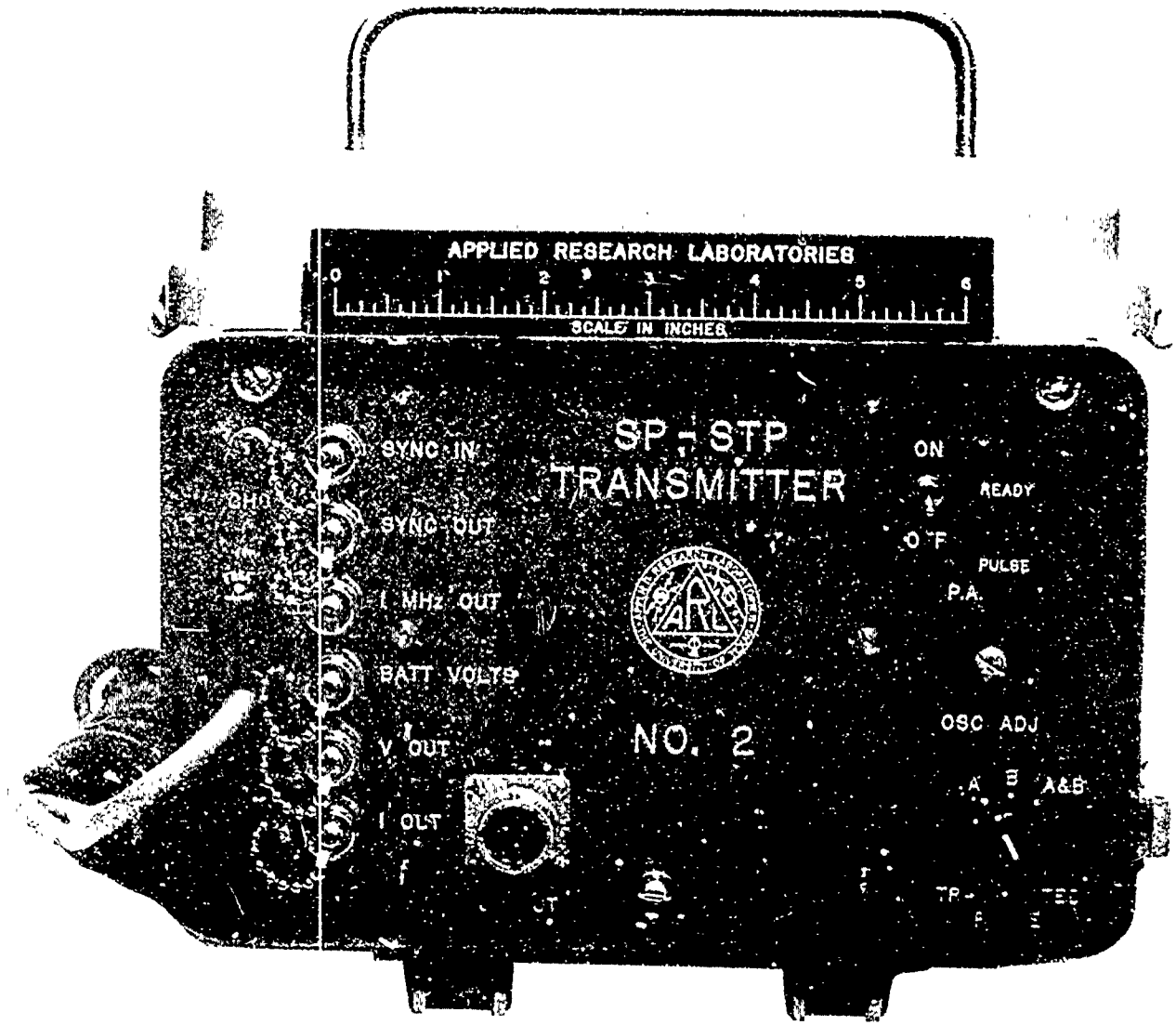

FIGURE 1
SP-STP FRONT PANEL

P.A. ON-OFF--The P.A. switch controls only the voltage to the power amplifier.

READY--The ready light begins to glow when the voltage on the power amplifier has built up to a suitable level for transmitting.

PULSE--The pulse light indicates each time a current pulse is applied to the transducer. The light glows brightly and then decays in about 1 sec.

OSC ADJ--The screw in the front panel can be removed to allow a tuning instrument to be inserted into the oscillator. The oscillator can then be adjusted to the frequency of the master clock oscillator.

TRANSMITTED PULSE--The SP-STP is capable of transmitting two identical pulses but offset in time. Pulse A is synchronized to the minute and is transmitted each 10 sec. Pulse B is delayed by 5 sec and the transmitter can transmit both pulses alternately, if desired, for a faster data rate.

Theory of Operation

The SP-STP is synchronized with a fixed position receiver and transmits a pulse periodically. The time delay between the time of transmission of the pulse and the time of arrival of the pulse is processed to determine the range and bearing of the submarine. The SP-STP transmits a 0.5 msec 19.23 kHz pulse which has a phase reversal at the end of 3 1/2 cycles. An exploded view of the SP-STP is shown in Fig. 2.

All signals are controlled by the 1 MHz oscillator. The 1 MHz signal is divided by a chain of CD4017AE dividers (see Fig. 3) to generate a 10 sec sync pulse and a 0 and 5 sec transmit start pulse. At the same time, the 1 MHz signal is divided by 26 to generate a 38.46 kHz signal which is twice the transmitted frequency.

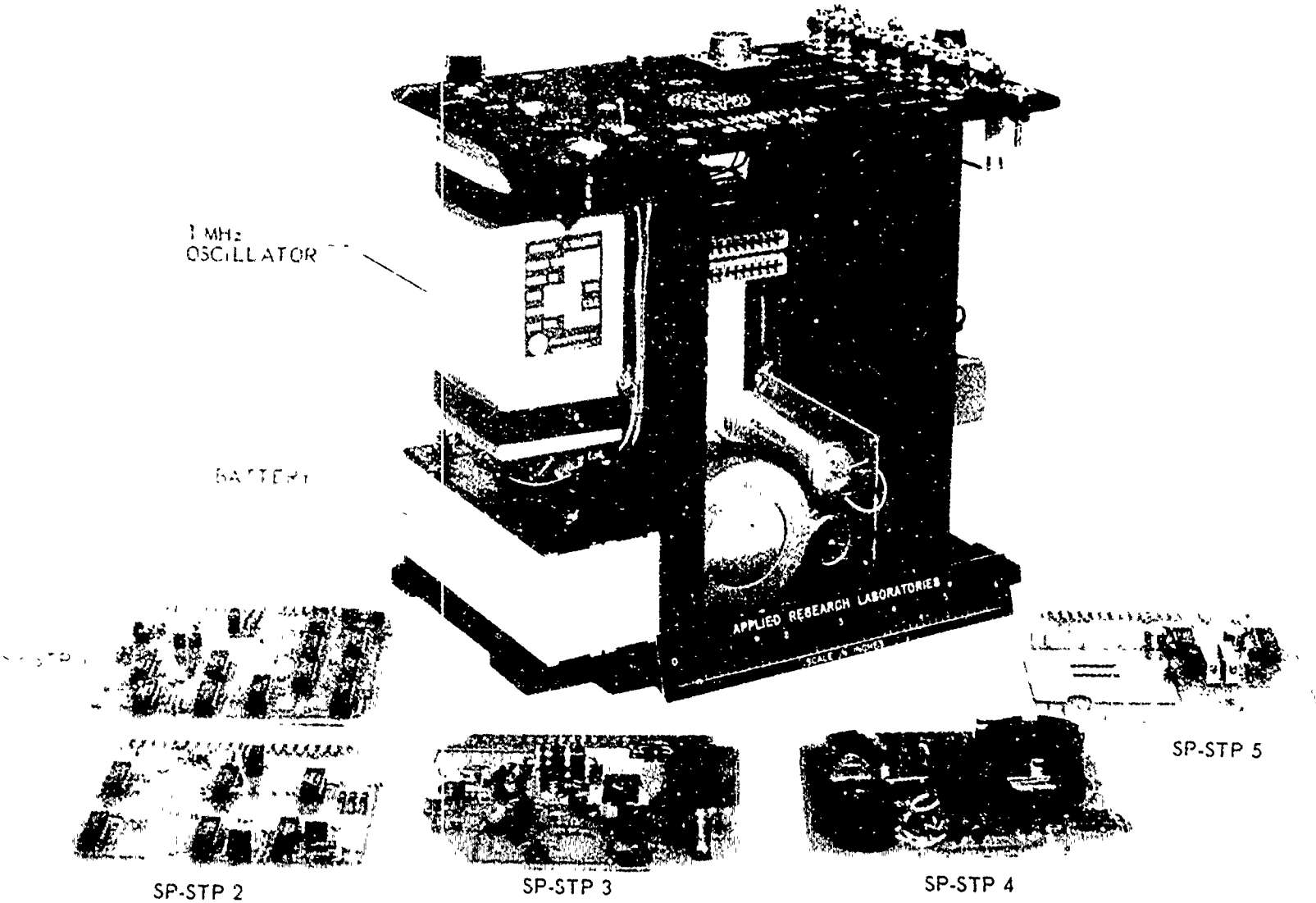

FIGURE 2
EXPLODED VIEW OF SP-STP

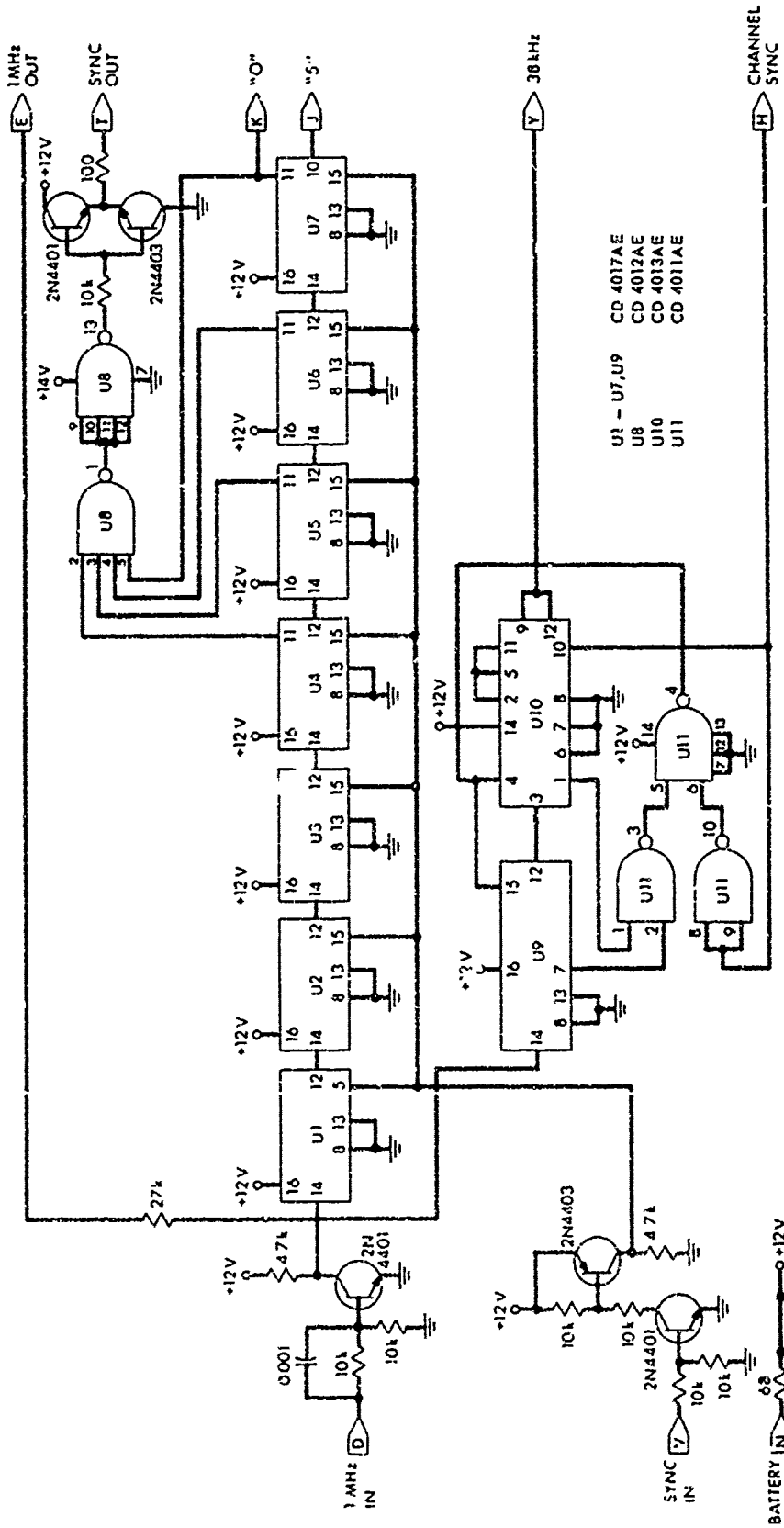

FIGURE 3
FREQUENCY DIVIDER
SP-STP 1

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The 38 kHz and the 0 and 5 sec transmit start pulses go into the pulse generator circuit shown in Fig. 4. The 0 and 5 sec pulses generate the channel sync pulse which starts the output signal. The CD4017AE ends the transmit pulse when ten cycles of 19.23 kHz are counted. The flip-flop chip C divides the 38 kHz pulse by 2, providing two 19.23 signals 180° out of phase. During the first three cycles, one of the phases is gated to output 1 and the phase is reversed for the remaining seven cycles. Output 2 is a single pulse with a 0.5 msec duration, starting one-half cycle before output 1.

The outputs from outputs 1 and 2 are applied to the input of the summing integrator (Fig. 5) to generate the signal that has a 180° phase reversal after 3 1/2 cycles. The battery charger is also located on the SP-STP 3 board and maintains a 90 mA charge current into the battery. The battery is maintained on charge at all times except during transit to and from the submarine. During the time it is in transit the battery provides power for the digital clock circuit so that synchronization with the master clock is maintained. The battery will power the clock up to 12 hours.

The 500 W power amplifier, shown in Fig. 6, couples the signal through the power transformer to the transducer. The source level in the horizontal plane of the transducer was measured to be +202 dB re 1 μPa at 1 yd.

Figure 7 shows the 24 V regulator and the 12 V regulator, along with the 5 V switching regulator. (The 5 V switching regulator is left out of SP-STP II since the oscillator in SP-STP II operates from 12 V).

The wiring diagram of the SP-STP is shown in Fig. 8.

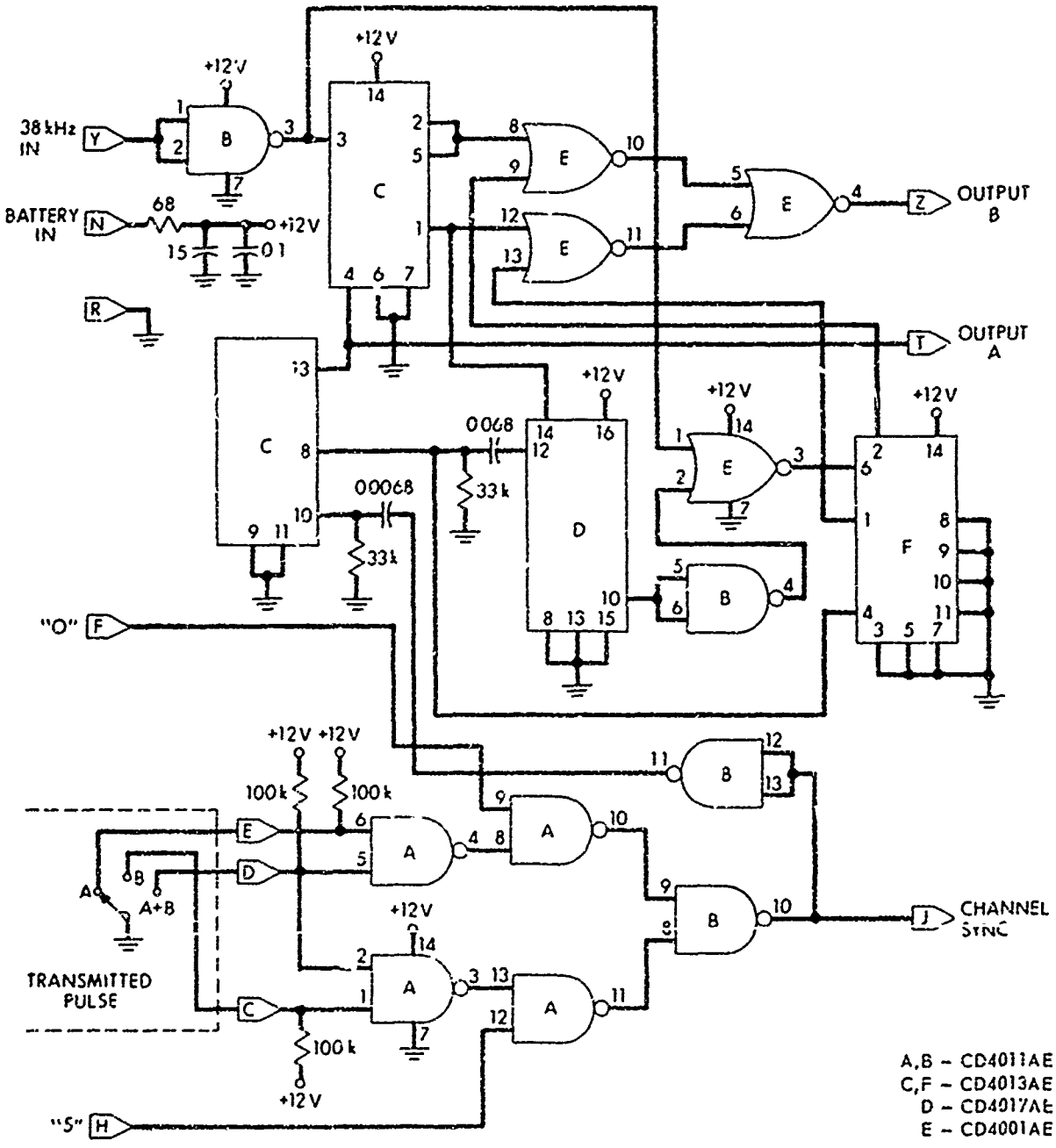

FIGURE 4
PULSE GENERATOR
SP-STP 2

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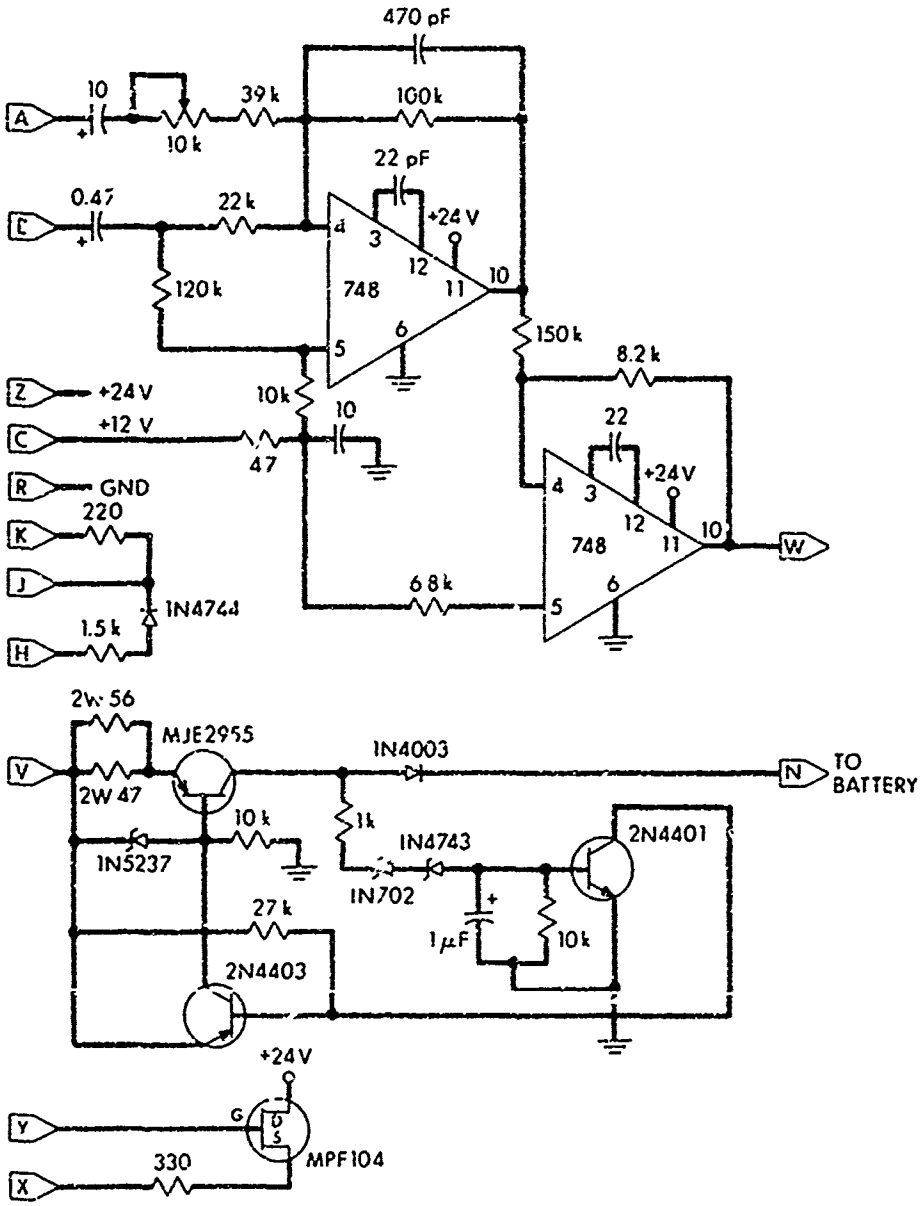

FIGURE 5
PULSE SHAPER AND BATTERY CHARGER
SP-STP 3

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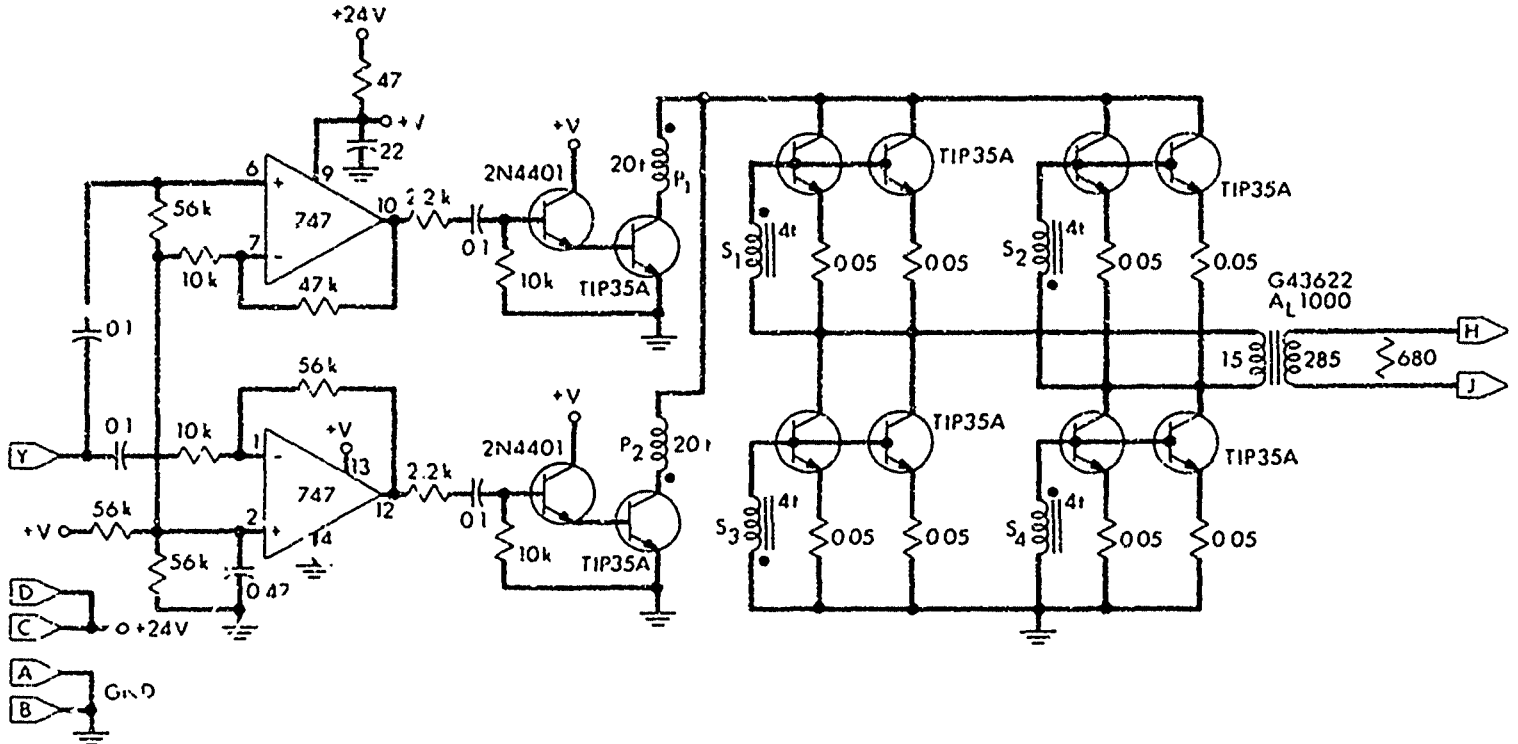

FIGURE 6
500 W POWER AMPLIFIER
SP-STK 4

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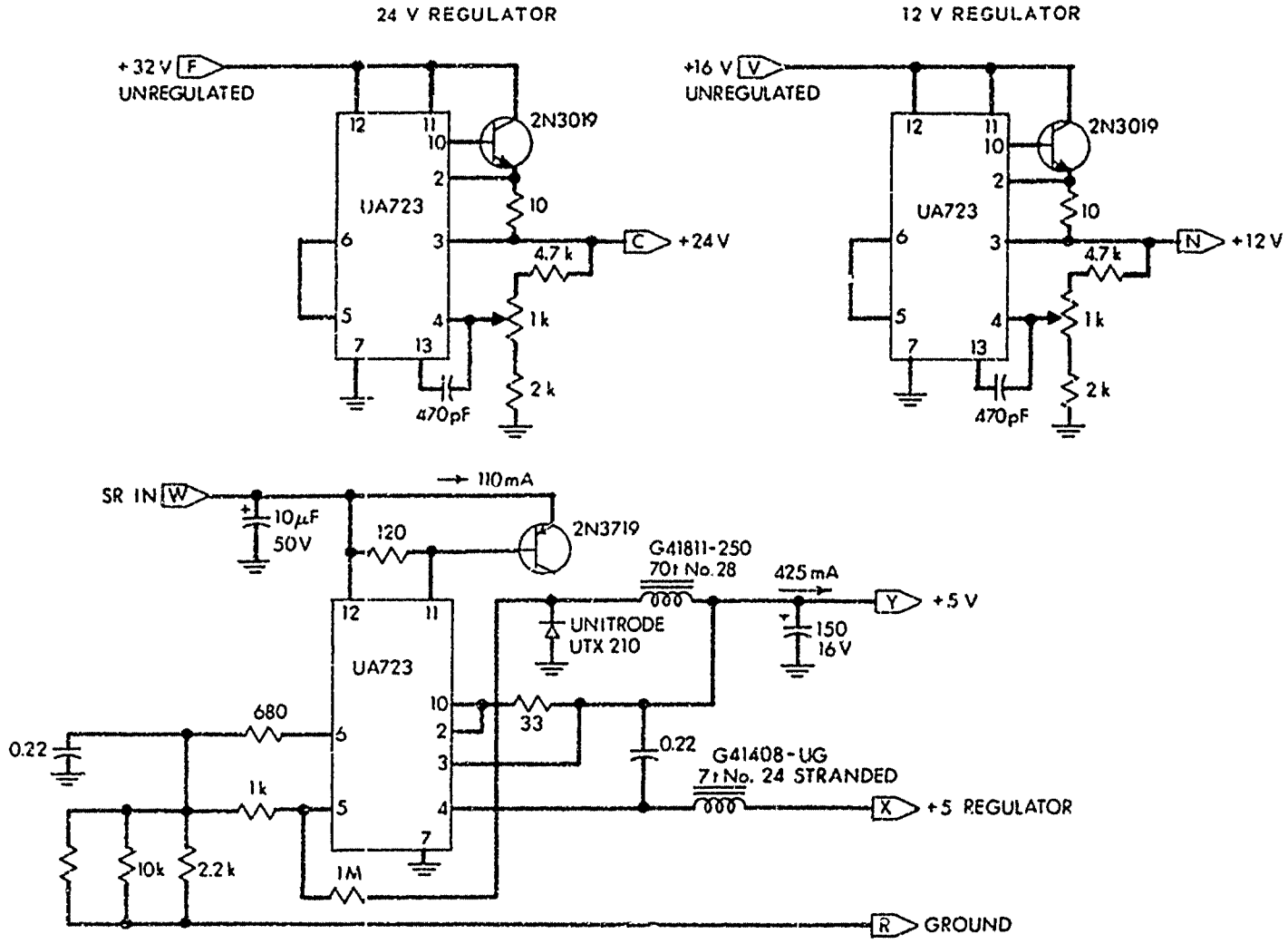

FIGURE 7
REGULATOR BOARD
SP-STP 5

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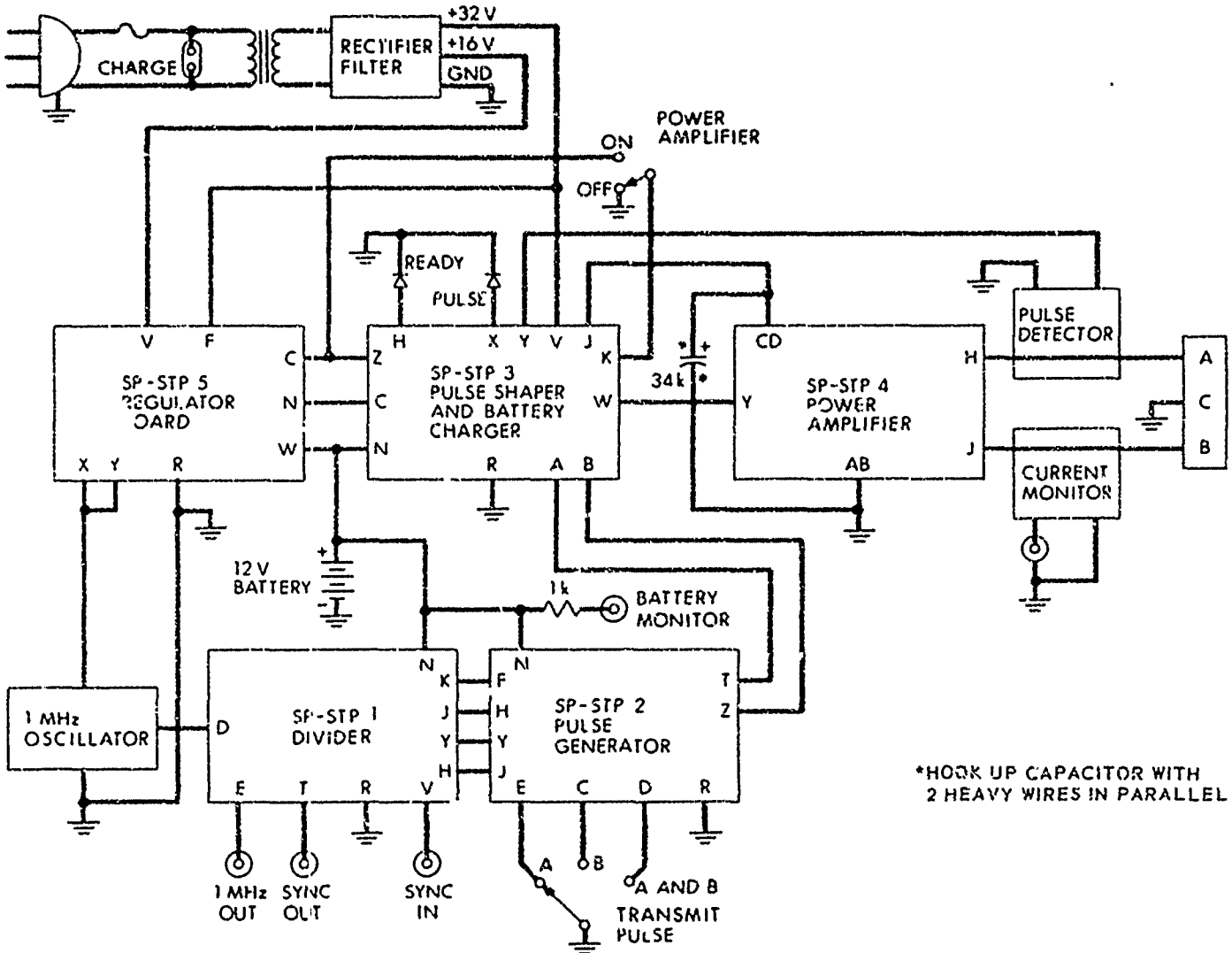

FIGURE 8
SP-STP WIRING DIAGRAM

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WSO - DR
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Acknowledgements

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